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ABSTRACT

During the 1990s discipline-specific associations have attempted to reform education with a variety of visions and standards. Most of these efforts have been independent of one another with minimal cross-curricular input on one another's steering committees and working groups. In some cases there appears to be explicit collaboration between related associations, whereas others do not appear to have been collaborative. This paper analyzes the resulting reform documents from a cross-curricular elementary school perspective. The procedural design of this document analysis involves three parts: (1) a synthesis of the recent elementary school reform, implementation, and planned change literature to develop an analysis framework; (2) application of the framework to the Year 2000 reform (1988-1995) in British Columbia to validate the framework; and (3) application of the framework to the current reform documents. The framework utilized a biological metaphor: elementary school as an ecosystem, elementary classroom as an ecosubsystem; teachers and students as organisms, teaching and learning niches; and education reform as evolution. The Year 2000 case study confirmed the utility of the framework. Application of the framework to current reforms in the United States revealed common learning and pedagogical attributes such as literacy, critical thinking, constructivism, and authentic assessment. Contains 41 references. (Author/PVD)

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Reforms, Visions, and Standards:

A Cross-Curricular View from an Elementary School Perspective

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Abstract

During the 1990s discipline-specific associations have attempted to reform education with a variety of visions and standards. Most of these efforts have been independent of one another with minimal cross-curricular input on one another's steering committees and working groups. In some cases, there appears to be explicit collaboration between related associations while others do not appear to have been collaborative. The purpose of this paper was to analyze the resulting reform documents (Benchmarks for Science Literacy, AAAS, 1993; Curriculum Standards for Social Studies: Expectations of Excellence, NCSS, 1994; Curriculum and Evaluation Standards for School Mathematics, NCTM, 1989; Professional Standards for Teaching Mathematics, NCTM, 1991; Standards for the English Language Arts, IRA/NCTE, 1996; National Science Education Standards, NRC, 1996; Technology for All Americans, IATE, 1996) from a cross-curricular elementary school perspective. The procedural design of this document analysis involved three parts: a synthesis of the recent elementary school reform, implementation, and planned change literature to develop an analysis framework; application of the framework to the Year 2000 reform (1988-1995) in British Columbia to validate the framework; and application of the framework to the current reform documents. The framework utilized a biological metaphor: elementary school as ecosystem, elementary classroom as ecosubsystem; teachers and students as organisms, teaching and learning niches; and education reform as evolution. The Year 2000 case study confirmed the utility of the framework. The application of the framework to the current reforms in the USA revealed common learning and pedagogical attributes—literacy, critical thinking, constructivism, and authentic assessment.

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Introduction

Public schools have experienced an avalanche of disconnected reforms during the 1990s that focussed on isolated problems with education, society, governance, and current practice. These real or manufactured crises (e.g., whole language, mainstreaming, drop-out rates, vouchers, charter schools, authentic assessment, cooperative learning, school violence, liberation education,) are promoted like breakfast drinks, athletic footwear and recent video releases. When the promotions are unsuccessful, reformers (promoters) blame the reform targets for failure; but infrequently do they examine the quality of the innovation, the implementation process, and their understanding of reform. Pogrow (1996) summarized a series of myths and realities about reform:

> Myth 1—You can change instruction via advocacy, inservice and training.... The advocacy is driven largely by philosophy, with only a smidgen of technique or research supporting the idea.
>
> *Reality 1*—Large-scale reform requires highly specific, systematic, and structural methodologies with supporting materials of tremendously high quality.

Myth 2—Theory is a useful guide for the design of programs and reforms.

Reality 2—Metaphor is much more important to the design of sophisticated programs than research and theory.

Myth 3—You can reform education by disseminating knowledge and leaving it up to practitioners to apply that knowledge.

Reality 3—Reform requires technology, methodology, structure, dosages, and materials. ...Thus, it makes no sense to expect practitioners to develop their own techniques for implementing a complex reform idea.

Myth 4—The most important change involves radical reformulation of existing practice, i.e., new paradigms.

Reality 4—The most important changes are incremental ones.

Myth 5—The best way to achieve reform is through school wide change/restructuring.

Reality 5—School wide change, while a nice idea, has never worked on a large scale and is probably not necessary.

Myth 6—You can develop learning through reforms designed to enhance correlates of learning, such as self-concept and empowerment.

Reality 6—The best way to enhance learning is to develop more powerful programs to enhance learning.

Myth 7—You can understand large-scale change by understanding what happens on a very small scale.

Reality 7—It's the scale, stupid! Large-scale change reflects properties that are often diametrically opposed to those in effect in small-scale research.

Myth 8—Directive programs cannot be effective on a large scale, and attempts to implement such programs rob teachers of their individuality.

Reality 8—It is possible to develop a new generation of far more powerful programs that can be effective on a large scale. (pp. 658-660)

Without consideration of these myths and realities, education reform will continue to recycle inadequate innovations, experience repeated failures, continue to waste resources, and experience decreased public support of schools and the teaching profession. Every time reforms are announced and not delivered on a schedule and on budget, the likelihood of future organization changes is reduced (Connors, 1990). Pogrow (1996) encourages reformers to stop the silly posturing and admit their lack of understanding, to create better implementation techniques and complete technologies, and to rethink the roles of colleges and universities.

This study attempts to respond to Pogrow's call-to-action to reform the reformers, to clarify the reform process as it specifically applies to elementary school, and to describe potential cross-curricular opportunities of the current reforms. Therefore, this study was conducted in three parts: a synthesis of the reform literature on elementary school to develop an analysis framework, a verification of

the framework against a recent reform in British Columbia, and an application of the framework to the current reform documents in the USA.

Background

Major content areas have now released their vision of language arts, mathematics, science, social studies, and technology literacy for the 21st century. The individual reforms have been critiqued independently by discipline-specific critics; but little has been written about the collective affects of these reforms on elementary schools, elementary teachers, and elementary students. Elementary classrooms and teachers are likely the most critical components of these innovations. Elementary teachers are educated as generalists with a basic general-liberal university education supplemented with a practice-oriented professional education. They likely view knowledge, disciplines, and epistemologies as unified with little attention to unique natures of language, arts, humanities, mathematics, social sciences, and science. Their beliefs and values assign high priority to humanitarian issues, language literacy, social skills, and physical development. Their beliefs and the culture of elementary schools encourage elementary teachers to seek cross-curricular commonalities, procedural clarity, and practicality.

This section of the paper attempts to identify a framework for analyzing the current reforms goals, instructional practices, and professional education demands from the interdisciplinary perspective and the unique culture of elementary schools. The complexities of the current reforms must be contextualized in the ecology and culture of elementary schools, the history of reforms, and the knowledge about reforms, implementation and managing organizational change.

As Ecology Metaphor for Reform: Evolution not Revolution

Educational reform can be like a revolution or like an evolution, but it is always a complex endeavor composed of several dimensions—educational theory, curriculum materials, instructional practice, implementation, and socio-political context (Anderson, 1992; Fensham, 1993; Gaskell, 1989; Yore, 1995). Experience in mathematics, language arts, science, and social studies education reforms, like world politics, indicates that revolutions infrequently have lasting effect and always produce a vigorous rebel opposition. Yore (1995) stated "educational change needs to be viewed as an evolving ecosystem with interacting components rather than a top-down military revolution" (p. 5).

Educational change viewed as an ecosystem suggests that habitats, component sub-systems, organisms, and niches are interactive. Changes in one component cannot be considered in isolation of other components. The precise relationship and control among these components in the elementary school environment are not well understood, leading to fuzzy anticipations and to the need for constant monitoring and adjustments. Huberman and Miles (1984) identified several interactive contextual features and implementation features across varied situations that influenced, caused, or blocked organizational change.

Elementary School Classroom Culture and School Climate

Nowhere in education are the complex, integrative interactions more dynamic than in the self-contained elementary school classroom. Several curriculum experts have identified drastic differences between the desired, official, reported, and actual curricula in the elementary school classroom. The desired, official, and reported curricula imply mutually beneficial balance across the disciplines. The actual curriculum and instruction in elementary school classrooms are less well documented; but many studies reveal priorities and sociocultural

traditions that stress language arts, mathematics, and personal development at the expense of science, social studies, and technology (Linn, Meyer & Hastings, 1994). Current instructional priorities are reading first, mathematics a distant second, and *who knows* is third; actual observed science teaching is minute, of low cognitive level, and drastically less than self-reported data indicate (Linn, Meyer & Hastings, 1994; Raizen & Michelsohn, 1994). Weiss (1978) suggested that science was ranked fourth in importance based on instructional time allocated by classroom teachers behind reading, mathematics, and social studies.

Individual self-contained classrooms reflect the internalized priorities, interpretations, and decisions of the classroom teacher; but curriculum and instructional changes are also influenced by the perceived school climate (Huberman & Miles, 1984). When schools exhibited school-wide changes, they were "marked by norms supporting collaboration, cohesive relationships, and a reasonable tolerance of diversity" (p. 178).

Environment pressure, demographics, unaddressed needs, and motivation are other school and classroom features that influence organizational change (Huberman & Miles, 1984). School systems, like ecosystems, respond to pressure resulting in diverse adaptations, adaptive advantages, and systemic metamorphosis. Successful schools apparently recognized, accepted, and valued that contextual features mediate change efforts and that teachers' motivation is directly related to the perceived educational value of the proposed change and the advantages of the innovation. Teachers are more likely to support innovations that have adaptive advantages for their students and themselves.

Historical Perspective

Yager (1992) encouraged current science education reformers to be aware of science education history and not to commit the same errors as the 1960s reform.

Hall (1992) pointed out that "change is a process, not an event" and that success depends on "policy makers, practitioners, and researchers [understanding] that all are part of the same effort" and ecosystem (p. 877). Unfortunately, many education officials still simply announce the reform or deliver the innovation to the classroom. Few reforms have explicitly recognized that lasting and meaningful reform takes time—lots of time (i.e., Project 2061).

With the benefit of 20-20 hindsight it is possible to identify the strengths and weaknesses of the 1960s reforms. Reforms are frequently justified by crisis of one form or another. The 1960s reforms were based on the 1957 Sputnik launch and the resulting space race, cold war, and international politics. The validity of these crises can be questioned; crisis-based reform requires crisis management and suffers from waning popularity as other crises develop.

James and Hord (1988) found "the real failure of the 1960s NSF supported elementary science programs was not their failure to produce appropriate learning outcomes, but their failure to be implemented" (p. 315). Sales records and self-report data indicate that these science programs (ESS, SCIS, SAPA, ESSP-Ill, etc.) were never used widely in elementary schools and that the best estimates of actual use were between 20-27% of elementary classrooms (Weiss, 1978). Clearly, some of the curricula developed were effective, but the systemic demands for materials, support, and professional development did not allow them to have full impact (Shymansky, Kyle & Alport, 1983).

The adaptive history of the organization also influences reform (Huberman & Miles, 1984). School districts that have a history of supporting and implementing innovation and that have superintendents and school boards with problem-solving orientations and supportive attitudes toward change increase the likelihood of success. Frequently these dispositions manifest themselves in realistic funding and budget priorities for innovations. Success is enhanced with actual and perceived

central office advocates (Huberman & Miles, 1984). Furthermore, the leadership must cascade across the systems with board members as advocates, superintendents and principals as sponsors, and classroom teachers as change agents (Connors, 1990).

Priorities, Policies, Accountability, and Personal Beliefs

Success of reforms is significantly influenced by the internal alignment of systemic values, priorities, policies, and procedures with the goals of the desired reform (James & Hord, 1988). If the administrative style is a lock-step hierarchy or a populist band-wagon, successful innovation is unlikely. The top-down system lacks sensitivity to the anxiety held by change targets, flexibility to transfer ownership of innovations, and tolerance for alternative interpretations. The band-wagon system frequently lacks the stick-to-it-ness and determination to implement change, which allows reluctant teachers to outwait the reform.

Several surveys of teachers' attitudes toward and beliefs about educational innovations reveal drastic differences between the respondents' dispositions and the desired goal (Czerniak & Lumpe, 1996). Elementary teachers frequently decide issues or solve problems based on adaptive advantage: effectiveness, pragmatics, and utility. The adaptation first must be effective and efficient in the classroom, and the theoretical validity does not influence the initial decision. Furthermore, elementary teachers must believe that the change will enhance their professional satisfaction. Unfortunately, reformers do not always anchor reforms to current effective practice and use language or motives understood by the reform targets—elementary teachers.

Instructional Models

Successful reforms that involve instructional innovations require fully developed models and examples of the desired teaching (James & Hord, 1988). Discovery and inquiry-oriented instruction were not well articulated in the 1960s reforms, except for the learning cycle which continues to be a popular and effective instruction model today. Constructivism, like discovery and inquiry of the 1960s reform, has many facets that lack clarity and practicality (Phillips, 1995). Some contemporary educators have failed to demonstrate that constructivist ideas are based in the elementary teachers' experience and value system—cognitive development, language, and sociocultural context. Currently, the practical models of constructivist teaching and learning are centered around the interactive-constructive, conceptual change and social constructivist perspectives. Each perspective has broad content area application and rejects the absolutist view of knowledge instead they promote an evaluative view or relativistic view of knowledge. Unfortunately, teachers appear to believe that constructivism and its related curricular assumptions (i.e., less breadth, more depth; importance of prior knowledge; resistance of misconceptions) are not essential to the current reforms and do little to implement constructivist teaching and learning strategies in their classrooms (Czerniak & Lumpe, 1996).

Resource Selection, Allocation, and Continued Consideration

Selection of instructional resources, allocation of funds, time and space, and distribution/duration of funding must be aligned with the innovation and the implementation process to ensure systemic coherence and to enhance success (James & Hord, 1988). Selection procedures that do not reflect informed opinions about the reform, allow reasonable diversity of interpretation within the system, and promote ownership will negatively influence reform success. Allocations must

reflect physical and human resources that include instructional ancillary materials, space, time, and expertise. Furthermore, the allocation duration must accept that implementation is a process not an event. Funding and resource allocations must consider initial capital outlay requirements and maintenance of the innovations. Implementation budgets that do not consider annual replacement costs required by the innovation will face future problems.

Role of Administrators, Mentorships, and Professional Development

James and Hord (1988) identified administrative support, supervisory help, preservice education, and professional development as barriers to successful implementation of the 1960s reforms. Current reforms have partially addressed these barriers by providing related standards (NCTM, 1991; NRC, 1996). Clark and Aestuto (1994) suggested that:

> Viewing teachers as members of a professional community focuses attention on norms of collegiality and on the ethics of professional practice. The shift has implications for the work of principals. Sources of control are built into the processes of professional work and collaboration, not into the hierarchy of authority. Principals' actions that focus on stability, goal setting, regularity, accountability, intervention, control, and efficiency are either redundant, destructive of cooperation and sense of community, or both. (pp. 517-518)

Current reforms encourage communities of learners and innovators, but many school districts and elementary schools are organized on a top-down authority model with the embedded adversarial roles of unions and management. The assumptions in the current reforms encourage shared authority, collaboration, interactive design and critique, and revision of professional practice which are made

more difficult in management-driven schools. Collaboration and shared authority relationships within school communities—students, parents, taxpayers, teachers, principals, district staff—require different assumptions about the work environment, competitive atmosphere, teacher evaluation, and professional development. Clark and Astuto (1994) believe that the:

> Opportunities for collaboration bring the knowledge and abilities of a number of professionals to bear on decisions about learning activities for individual students. Meaningful collaboration replaces the control that is characteristic of management-driven organization with the empowerment of professional staff members. Collaboration reduces isolation, and, as a result, professional decisions become more public and more accessible for the scrutiny of colleagues who may offer useful advice (p. 518).

This new environment responds to children, supports the efficacy of individuals, fosters collegiality and collaboration, and assesses actions—building on success and learning from failures.

Any success of the current reforms will be partially determined by the professional development of the school staff—"teacher learning must be the heart of any effort to improve education...and...conventional professional development [is] sorely inadequate" (Sykes, 1996, p. 465). The 1960s reforms recognized the importance of professional development of teachers, district staff, and principals; but the *one-shot* workshops and *it's broken so let's fix it* philosophy were counter-productive. Contemporary professional development needs to mirror the growth in expertise that encourages exploration, reflection, and consolidation of effective practice within a supportive network of colleagues. "Teachers need assistance in trying-out new practices in their classrooms, along with the opportunity for feedback

and dialogue. ...[cognitive coaching and other] approaches often engage teachers in learning about their own learning, in studying their own teaching, and in sustaining relationships with other teachers" (Sykes, 1996, p. 467). Such professional mentorships will clarify visions, develop local standards, and provide practical details to complete the innovation technology required for classroom implementation.

Implementing and Managing Organizational Change

Moffett (1994) cautioned reformers against the assumption that Deming's business renewal principles and approaches can be used whole-heartedly to guide education reform. Size and scope of the innovation relate to the size of the change achieved, but not to success or failure in an absolute sense—"the general message is: more attempted, more gained" (Huberman & Miles, 1984, p. 181). Furthermore, Huberman and Miles found that schools do not attempt changes that do not fit the contextual situation of school, but successful organizations do monitor the change process and modify the innovation, adjust the vision, change the standards and regulate the process to achieve actual fit. Administrative latitude, pressure, and support were not as direct influences as commonly anticipated; and there appears to be mediating effects among these features and with the scale of reform and the contextual situation. Problems arising during the implementation directly reflected the size and scope of the innovation and were more critical near the final phases of implementation.

The underlying assumptions and visions of the current reforms do not require scrapping schools and starting from scratch. Moffet (1994, p. 590) stated:

> If a way is cleared, most of the desired reform can consist simply of throwing out unjustified practices that now fill the curriculum and pulling together into a unified learning the

> many excellent practices that generations of educators have long advocated and that some schools have managed to implement in bits and pieces. ...So the prospect for reform is much more positive than it looks: act on what we know about learning, and don't let politics and economics obscure the obvious practical knowledge staring us in the face from the whole environment.

Drucher (1985) identified three fundamental conditions that nourish successful innovations: (1) clearly defined, simple ideas that includes a complete system for implementation and dissemination; (2) start small, focussed and regularly consolidate; and (3) knowledge-based innovations are least likely to succeed, and success is possible only if all component knowledge is available.

The volume, speed, and complexity of change are increasing within schools. Nowhere is the turbulence more drastic than in the self-contained elementary school classroom where, unlike the secondary school in which change can be compartmentalized and isolated, the system and curriculum are more interactive and interdependent resulting in unanticipated consequences, low predictability, less control, less time to react, and less durable solutions. The elementary school teacher must assimilate macro-changes, organizational changes, and micro-changes that require significant intellectual, psychological, and physical energies and involve significant personal, relational, and professional risks.

The assimilation of change places stress on the change targets—elementary teachers, students, parents, and administrators. The impact of macro-changes in the State Department of Education or the U.S. Office of Education involves little stress, while organizational changes in the superintendent's office and the political orientation of the school board have greater related stress; but the micro-changes in the teacher's life and classroom have the greatest stress. Unfortunately, these

stressors have an accumulative effect that compounds the impact on elementary school teachers increasing the potential of *future shock*. Future shock is "that point in time when people can no longer assimilate change without displaying dysfunctional behavior" (Connors, 1990, p. 7). Figure 1 illustrates the aggregate impact of several changes on an elementary school teacher and on five specialist secondary teachers. The current uncoordinated content reforms in language arts, mathematics, science, social studies, and technology run the chance of causing dysfunction in many elementary classrooms.

Insert Figure 1

Managing organizational change as an ecological approach to implementation and execution can reduce the impact of stressors and increase the threshold of dysfunction and failure. The cost and effort of planning, training and management are justified when the cost and risk of failure are high. Connors (1990) identified the costs as decreased credibility; lost opportunities; wasted money, time, and human resources; decreased morale; threatened job security; and learned avoidance. He identified the risks as strength of sponsorship and power to legitimize change, targets' resistance to change, level of consistency between change and target culture, and skill level of the change agents.

Some reforms are based on the all or none analogy of jumping off a fiery platform to save your life (Connors, 1990). Educational reform is far less straightforward than this, assumes change is a vector quantity (magnitude and direction), and requires an incremental metamorphosis strategy. Incremental change (like metamorphosis) involves transitional states that require consolidation to increase stability and decrease stress, focus undirected energy, and reduce conflict (Figure 2). The incremental changes are judged on progress toward the desired state

and accepts the final transitional state may not fully represent the desired reform. If systemic change is to avoid failure and future shock, it must address the causes of resistance, systemic inertia, clarity of cause, and sustained momentum.

Insert Figure 2

Analysis Framework for Reform in Elementary Schools

Taken collectively reform, implementation and organizational change literature supports an ecological perspective of the elementary school embedded in other larger ecosystems (society, community, school district) and an evolutionary perspective of change leading to metamorphosis of the organization. The basic interdependent organisms in the ecosystem include students, parents, teachers, principals, central office administrators, and school board members. Within the ecosystem are numerous interacting subsystems (classrooms) contributing to the success of the ecosystem, but acting somewhat independently of each other within the constraints and purposes of the umbrella ecosystems (school district and school). The niches of the organisms (teachers and students) vary somewhat as their roles and functions are only loosely defined by current practice and policy as teaching and learning a diverse set of outcomes: knowledge, abilities, attitudes, social development, and physical development. These ecological systems, subsystems, and organisms respond to external and internal pressures, such as imposed needs, funding, sociopolitical lobbies, interdependence. The complexity of the response approximates a non-linear function of scale and potential interacting components, leaving questionable the generalizability from small ecosystems to large diverse ecosystems. Pressures need to be moderated to prevent dysfunction and extinction. The adaptive responses are fundamentally survival and goal driven. The resulting adaptations must address the environmental pressures, manage stress, and

provided "win-win" adaptive advantages to the organisms. Adaptation can be a staged metamorphosis involving a series of incremental changes, consolidations and stabilizations followed by another achievable change, consolidation, and internal stabilization. Ecological constraints may modify the achievable adaptation from that of the desired innovation to fit the ecology and culture.

British Columbia Case Study

The analytic framework developed from the literature review was applied to recent reforms in the British Columbia public schools. This case study exemplifies the value of the analytic framework for assessing the success potential of a reform and foreshadows the prospects for reform represented by the standards documents.

The government of British Columbia undertook an ambitious reform of the education system after commissioning a public inquiry. The Sullivan Commission (1987-88) held public meetings, contracted research studies and position papers, and produced a number of recommendations for education renewal in British Columbia public schools. In the end the government decided on several initiatives that were proclaimed under the banner of Year 2000 (BC Ministry of Education, 1990). There were many reforms initiated; however, three emerged as central over the period of implementation. First, the organization of schooling was divided into three programs, primary (K-3), intermediate (4-10), and graduation (11-12). Second, there was a broader vision of the fundamental character of classroom instruction that emphasized personal well-being along with academic achievement in a more integrated curriculum. Third, evaluation was to include a large measure of authentic assessment. Prior to launching these reforms, the Ministry of Education had satisfied itself that there was widespread public acceptance of these initiatives through the findings of the Sullivan Commission and responses to the initial draft version of the Year 2000.

The case study focuses on language arts reform in the Primary Program and the Intermediate Program. This focus was taken since these programs (K-3 and 4-10) cover the elementary school years (K-6), the central philosophy of the B.C. reform is similar to the English Language Arts Standards (NCTE/IRA, 1996), and the Year 2000 successes and failures illustrate a drastic differences between the primary and intermediate programs.

The Year 2000 took as its central premise that language, like all learning, was fundamentally constructivist and that an approach loosely referred to as "learner centered" was the most promising procedure to follow. In language arts this child-centered constructivist philosophy had been termed "Whole Language." The goals of Year 2000 closely resemble the principles cited by Goodman (1990) *What's whole in whole language?*

The life cycle of reform in B.C. began routinely enough in the call for a coherent approach to learning in the Year 2000. The basic approach adopted in B.C. was to recognize that the general public was most satisfied with education at the primary level and least satisfied or confident in education at the secondary level. Given this public opinion, it seemed obvious to the government planners that what was needed was to legitimize the widely held practices of the primary school and to infuse these practices across the entire public schooling range as the Year 2000 innovation.

None of these initiatives raised any irritation amongst K-3 teachers. In fact, at this time most primary teachers were actively declaring themselves "whole language teachers." At the level of principle and theory, the Year 2000 was widely accepted by teachers. Unfortunately, the application of these reforms in the Intermediate Program (4-10) and Graduation Program (11-12) were fuzzy; and many procedures did not fit the content specialization, system-wide examination, and

academic-orientation of the upper grades. The Year 2000 was terminated well short of the millennium (1995).

There were some general features of the Year 2000 that have been repeatedly cited as sources of the decline. Principle amongst these was the proposal to undertake all student evaluation in an ungraded way. That is, both letter grades would not be used in reporting student progress, and all classrooms would include more than one grade level. But there were other features that contributed to the demise of the Year 2000. In particular, the administrative authorities (Ministry of Education) attempted to manage the reform through curricular change. This was done through the creation of curriculum implementation panels made up largely of practicing teachers. There were curriculum panels established for all of the content strands and each of the three school programs: primary, intermediate, and graduation. Each curriculum committee was charged with the task of independently interpreting the general philosophy into classroom practice. As the basic philosophy of the Year 2000 was being elaborated by the Ministry of Education, the Primary Foundation Document (1990), which described in detail an instructional response to the three main reforms: constructivist teaching (illustrated principally through whole language), integrated curriculum and authentic assessment, was prepared, published, and distributed. Even as intermediate and secondary teachers were struggling with the principles of the Year 2000, primary teachers were on side.

The Ministry had made a commitment in the Year 2000 for system-wide change while knowing the primary grades (K-3) had already achieved the reform and the senior grades 11 and 12 were largely sheltered from the effects of constructivist teaching by the established curricula and from authentic evaluation by provincial examination policies. The only initiative placed in front of them was curricular integration. In 1991 the secondary teachers held a major conference where

they re-affirmed their commitment to subject area specialization and rejected the proposed interdisciplinary strands.

A dichotomy of curriculum was now established. Primary teachers had taken a clear position about their priorities, favouring a generalist, integrated curriculum that emphasized the social development of children; and the secondary teachers were maintaining a subject area orientation and the priority of intellectual development. Stuck in the middle was the intermediate program, consisting of a new affiliation of elementary teachers from grades 4-7 and secondary teachers from grades 8-10. The intermediate program became locked in a tug-of-war between philosophical camps.

The strategy of placing responsibility for curricular implementation largely in the hands of committees of teachers meant that there was limited coordination of initiatives across levels and strands. There were two consequences: first, committees adopted separate and even idiosyncratic interpretations of the reform initiatives; second, teachers were bombarded with a flood of diverse documents that separately addressed the curricular issues. In 1991-92 there were about 400 separate Ministry of Education documents sent out to teachers describing the new instructional and evaluation practices. In the midst of all this, the intermediate teachers remained perplexed.

The primary school environment was untroubled by the basic reforms. Anecdotal reporting for grades K through 3 had been policy since the 1970s. The curriculum in language arts (1978) had embraced a philosophy that would become known as whole language, and subject integration in the form of instructional themes was widely practiced. The reform initiatives were already part of the environment of the primary school, and most primary teachers had already adapted to them.

Secondary teachers were not faced with much pressure for innovation. There had been some suggestion for innovation and adaptation but this had not been acted upon. The environment of the senior secondary school remained largely unaffected by the reforms, except for an increased attention toward applied academics and the world of work.

It was really only the intermediate teachers who were under pressure to change. Moreover, the whole notion of a 4-10 school environment was new. So the intermediate teachers were under extreme adaptive pressure not only from the reform initiatives, but also from the attempted merger of two previously separate school habitats and cultures. Grades 4-7 were usually housed in elementary schools and grades 8-10 in secondary schools. There was no history of a new schooling sub-system that comprised elementary and secondary teachers, and there was no attempt to build such schools.

The success of the primary program was the result of many years of incremental change that systematically considered teaching approaches, instructional resources, and assessment techniques led by the B.C. Primary Teachers Association. Unfortunately, basic language arts approaches proven in primary classrooms were generalized to other content areas and grade clusters without verification in these new situations. The Primary Program was put at risk because of a last-minute addition of dual entry (September and January) for kindergarten students.

The reformers failed to notice that the pressures for change on the teachers in the three schooling sub-systems were not equivalent. The fragile nature of the apparent acceptance of the reform initiatives was made evident when the government capriciously added a call for dual entry into the primary school. This innovation had not been previously incorporated into the primary school sub-system, the logistics and staffing practices had not been developed and its

introduction resulted in widescale distress amongst primary teachers. The addition of dual entry placed stress on primary teachers who were gladly embracing the basic reforms and were expeditiously incorporating them into classroom practice increased thereby increasing the risk of dysfunction (future shock).

Meanwhile, buoyed by the apparent success of the primary implementation, the principles of whole language and integrated curriculum were generalized to other content areas and programs without verification in these new situations. The result was wide-scale talk about educational reform while material and practices remained unchanged. Despite a flood of government documents that proclaimed the new paradigm, instructional practices were largely unchanged.

Thus it was not really the case that primary teachers underwent the reform while intermediate teachers did not (Case, 1994; Crawley, 1995). Both primary and intermediate teachers continued to use long-standing practices; only the primary practices had previously undergone a gradual metamorphosis, which emerged as compatible with the reform initiatives. The intermediate teachers however had not undergone the same change, and their repertoire of established practices did not appear as congruent with the Year 2000 reforms. Furthermore, the instructional innovations that had been spreading gradually through the primary system were suddenly thrust onto the intermediate teachers where they were not so easily incorporated.

Throughout the period of the 1990's schools in British Columbia faced ever increasing pressure as a result of declining levels of funding. Less money was available for the acquisition of new material. In addition, stagnant student populations resulted in few new teachers entering the schools. The result was that the same teachers continued to teach with the same material while the government proclaimed the new reforms.

A change in government resulted in some changes of the reform logo to ensure a new label but without renewed conviction or funding. This approach continued for a few years until the government announced that the Year 2000 was no longer the desired reform and quickly erased most signs of the reform.

The rise and fall of the Year 2000 reform in British Columbia is potentially a test case for the nature of reforms proposed in the standards document. At the very least this case study shows the fundamental nature of gradual evolutionary change in teaching practices and the folly of moving a productive innovation from one environment and imposing it across the system. It also illustrates the operation of several key elements in the ecological metaphor for education reform. First, the primary program underwent a long period of adaptation before the pronouncement of visionary principles. Hence the success of the reform in the primary program was more apparent than actual. The rejection of dual-entry kindergarten suggests that pronounced sudden change was not appreciated by the primary teachers. Secondly, the pressure to change classroom practices was not initially curricular in the primary grades but rather professional. At the time when primary schools adopted an non-graded evaluation policy, the curriculum was not changed. In fact, the language arts curriculum was implemented with an authorized conventional basal series, Ginn 721. Under the pressure for change in evaluation, primary teachers evolved not only coherent techniques for authentic evaluation, but also more constructivist approaches to classroom instruction. By the time a new authorized curriculum was announced in 1991, there was already a critical mass of primary teachers who had embraced whole language.

Intermediate teachers on the other hand had not been under any pressure to change existing practices until 1990 and the Year 2000. As a consequence they were expected to respond to the declaration of principles. They did respond, not by changing in any particular principled way, but rather by fragmenting into isolated

philosophical "camps". While many teachers declared support for the principles, classroom practice remained unaffected (Leithwood & Dart, 1992). Perhaps over time some coherent adaptation may have emerged. But the repeal of the Year 2000 initiative in 1995 left the intermediate classrooms largely as they had been in 1990. Evaluation change appears to be a strong pressure for curricular and instructional changes, while declared principles appear to be a weak change agent.

Document Analysis

Like science inquiry and technological design, educational failures can be productive if properly analyzed and utilized to map new heuristics. Strategic reorganization and planning can be improved if new perspectives and insights are introduced. It is apparent from the analysis and synthesis of the literature and the British Columbia case study that the current proposals for reform in language arts, mathematics, science, social studies, and technology must address six key factors for successful implementation in the elementary school:

1. Realize that the elementary school culture and context are uniquely different from the secondary school culture.
2. Capitalize on the generalist nature of elementary teachers' background, their priority for language, personal development, and social development, and their belief in integrated disciplines.
3. Accept that reform is an incremental, progressive process requiring a series of achievable steps and consolidation.
4. Provide for cascading leadership with classroom ownership.
5. Anchor innovative instruction in current beliefs and effective classroom practice, and coordinate innovations with high prior goals.

6. Clarify constructivist teaching and learning, authentic assessment techniques, literacy, and critical thinking.

Procedures

This part of the study utilized a document analysis procedure to identify potential assertions found in the new reform documents in language arts (IRA/NCTE, 1996), mathematics (NCTM, 1989 & 1991), science (AAAS, 1993; NRC, 1996), social studies (NCSS, 1995), and technology (ITAE, 1996). Preliminary assertions were discussed with language, mathematics, science, social studies, and technology educators and elementary teachers familiar with specific reform perspectives. The elementary teachers who were graduate students were asked to deliberate in cross-curricular and discipline-specific groups the meaning of the new reform documents and their cross-curricular potentials. The teachers were asked to write individual essays about critical aspects of the documents—nature of the specific discipline and the cross-curricular influences, specifically, the role of language arts in the other disciplines. These discussions and papers were analyzed for common reform ideas. This synthesis built upon a project that explored elementary school curriculum from a unified perspective commissioned by the British Columbia Ministry of Education (Williams, Yore, Craig, Liedtke, Riecken, Russow, Sheppy, & Turkington, 1989).

Preliminary results indicated that with effort and imagination the disciplines can be defined with common features; for example, literacies across all curricular content areas and critical thinking are common epistemic goals of all reforms. Teaching and learning are portrayed as a constructive process in a sociocultural context, and evaluation requires authentic assessment alternatives that must be aligned with goals, instruction, and context. These common outcomes and pedagogical considerations were used to guide the final document analysis.

Results

The preliminary assertions were used as key ideas, and each document was analyzed to tally evidence of support and non-support. This evidence indicated that the documents stressed literacy and critical thinking for "all" students, using constructivist teaching approaches and authentic assessment techniques. Next, critical passages were extracted from the documents to illustrate the common and diverse aspects of these assertions (Table 1-6).

Insert Tables 1 to 6 here

Learning Outcomes. Each reform document clearly identifies that the expectations are directed to "all" students. Reformers must keep this central in their planning and implementation. The 1990s reforms are directed to every student and address the global goal of an educated citizen, which emphasize the worlds of work, daily decisions and personal development, not as the 1960s reforms that emphasized academic and professional goals.

In light of the integrative, generalist nature of the elementary school culture it appears that a slight blurring of the lines of demarcation between the disciplines is possible and advisable to facilitate acceptance and implementation. The following definition captures the common essential features of each discipline, while providing a friendly cross-curricular spirit (Williams, et al., 1989)

- LANGUAGE ARTS is people's attempt to search out, describe, and explain patterns of communication, linguistic symbols, and language systems.
- MATHEMATICS is people's attempt to search out, describe, and explain patterns of quantity, shape, and order.

- SCIENCE is people's attempt to search out, describe, and explain patterns of events in the natural world.
- SOCIAL STUDIES is people's attempt to search out, describe, and explain patterns among people, society, and the environment.
- TECHNOLOGY is people's attempt to search out, describe, and explain designs used to adapt the environment to meet or alleviate the needs of people.

Each definition stresses the people-made nature of knowledge; the risk and struggles of disciplined inquiry, design, and problem-solving; the importance of generalizable patterns; and unique foci and limitations.

Content literacy can be described as the abilities and habits of mind to construct understanding; the big ideas, unifying concepts, and informed opinions constructed; and the communication strategies to inform and persuade others about these big ideas, concepts and opinions so they can take informed actions. This conception clearly reflects that language is both a component of and an instructional path to content literacy and that the individual discipline and epistemology will influence the content of the literacy.

Examination of the evidence in Tables 1 to 6 illustrates common features of content literacy as well as critical thinking across language arts, mathematics, science, social studies, and technology. There are also differences. However, in the context of the elementary classroom, there appears to be no compelling reason to address the differences, because teaching in the elementary classroom is naturally oriented towards a common set of instructional assumptions as a consequence of relying on only one teacher for all the disciplines. Incorporating the differences in underlying assumptions would only create discontinuities for the teacher. In the elementary context congruency becomes a more fundamental issue.

Critical thinking is fundamental to literacy, a desired intellectual response to a problematic situation that justifies what to believe or to do about a critical challenge. The informed judgment and persuasive communication that characterize literacy are facilitated by understanding what counts as good reasons and the habits of mind to strive for sustainable judgment. Each document explicitly mentions critical thinking, critical responses, problem-solving, analysis, evaluation, and other higher-order thinking. Cognitive tasks relevant to critical thinking are evident in all documents (interpret, infer, analyze, explain, assess, criticize, argue, buttress, judge, decide, justify, prove), but the evaluative judgment and justification of relative merit are underrepresented in some reform documents. The inquiry standard (NRC, 1996), the habits of mind (AAAS, 1993), segments of evaluation (NCTM, 1989), the skills list (NCSS, 1994), some language arts standards (NCTE & IRA, 1996), and language scattered throughout the technology document (ITEA, 1996) provide anchor points for a more comprehensive view of critical thinking.

Separate standards for critical thinking would provide the texture and the details to understanding how critical thinking is central to inquiry and problem solving. Such an addition would strike a high degree of accord with elementary teachers and provide common ground for a unified perspective and integration across curriculum. A separate thinking standard would illustrate the cross-curricular aspects of critical thinking and reduce the stressors on elementary teachers who lack the substantial time that integration requires (Pogrow, 1996). Clarity of critical thinking needs specific consideration since analysis of the individual standards does little to address the fuzziness.

Pedagogical Perspectives. Constructivism is implicitly presented as both a philosophy and methodology in the reform documents. The specific face of constructivism varies from discipline to discipline. Language arts appears to embrace the social-constructivist, relativistic view of knowledge, while mathematics

appears to embrace an interactive-constructive, evaluative view of knowledge, leaving science, social studies, and technology distributed between these dipoles. The lack of agreement apparently reflects the diversity of opinion on the nature of knowledge and epistemology of the disciplines and avoids the conflict between the modernist and post-modernist camps. This clearly illustrates that these reform documents were products of a sociopolitical process.

Assessment alternatives appear to be a common feature in the reform documents. The reform documents that explicitly address assessment promote the use of authentic assessment tasks that sample actual knowledge constructed, strategy performances and applications of knowledge, communication and critical thinking. The mathematics and science documents take a lead in specifying assessment approaches, while the other reforms leave assessment for future consideration.

Discussion and Implications

This analysis of the current reform documents from a cross-curricular, elementary school perspective yielded significant findings about the implementation of reform as well as discovering common themes across the individual reforms. In particular, the evidence in support of an ecological and incremental approach to implementation is overwhelming. This fact, in conjunction with the observed commonalities across reforms, suggests that the reforms need not be approached all at once. Rather, one area of reform could serve to initiate the reforms that would anchor the other reforms, which then gradually spread and expand through the system. This means that each reform site needs to be strategically assessed to determine the appropriate foundations of effective practice for reform.

In many primary classrooms this would probably be language arts, since the constructivist perspective and authentic assessment have become familiar in this

context under the literature-based or whole language approach to early reading. In other classroom clusters mathematics might be the most appropriate foundation, since this reform has been active longer than the other reforms. It is critical that the new reforms capture the success and effectiveness in current practice since much of the new reforms simply recognize sound teaching, assessment of literacy, and critical thinking that have long been part of effective schools and exemplary programs.

Anchoring science reform to other content areas allows leverage not possible by independent effort, but it also involves some sociopolitical side effects. It may result in a specific view of knowledge, epistemology, or interpretation of constructivisim somewhat different than promoted in the science standards (NRC, 1996) and elaborated by the science benchmark (AAAS, 1993). Reformers must determine the risks and benefits of such trade-offs.

Another concern for interdisciplinary efforts are the application of teaching and assessment approaches developed in a single discipline to other disciplines without proper verification and adjustments. The success of whole language can be mistakenly applied to whole mathematics and whole science without recognizing the conceptual demands placed on elementary teachers. The effectiveness of the whole language approaches in part reflect the teacher's ability to make on-line decisions of language instruction with 24-30 students. Elementary teachers have been able to meet these demands, but it may be more difficult for these same well-intentioned teachers to meet similar demands in mathematics and science since many elementary teachers have much more limited content-pedagogical knowledge in these areas.

The promise of an interdisciplinary systemic reform can be demonstrated by Science: Parents, Activities, and Literature (PALs) (Shymansky & Dunkase, 1996). Science PALs utilized interdisciplinary connections with NSF-funded curricula as

the basis for a system-wide reform effort in the Iowa City Community Schools and as a teacher enhancement effort. Central to these efforts were connections with parents, literature, mathematics, and social studies. Teacher advocates and lead teachers developed, tested, and revised science teaching units based on activity-based science units (STC, FOSS, INSIGHTS). They developed a bookbag for home use to assess children's prior knowledge and to incorporate parents into the science program. School district staff from mathematics, language arts, and social studies help enrich the science units with extension activities. Workshops focus on specific conceptual issues, instructional ideas, and assessment techniques.

Elementary schools and classrooms are highly interdependent ecosystems with interdisciplinary cultures that are unlike the secondary school ecosystems with loosely connected specialized discipline-specific cultures. In secondary schools reform is compartmentalized in which pressures to change are not transferred across the system. The B.C. case study demonstrated clearly how secondary teachers used their strong discipline traditions and associations to thwart external pressures for reform. Elementary school teachers take the opposite position since their traditions embrace interdisciplinary approaches. Unfortunately, the current reforms are not coordinated and integrated. If this continues, there is an increased chance that the accumulative stress will put the elementary school ecosystem into future shock resulting in dysfunction and extinction of the reforms. The current reforms need to develop leadership within the reform efforts that will take ownership of the reform translating the reform visions into local alternatives anchored on local standards, traditions and effective practice (Fullan, 1996, Scheurich & Fuller, 1995; Wilson, Peterson, Ball & Cohen, 1996). Such reforms take time, are incremental and require determined effort (Connors, 1990).

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Table 1: Reforms, Visions and Standards–*National Science Education Standards* (NRC;1996)

Goals	Pedagogy	
	Constructivism	Authentic Assessment
Literacy involves the abilities and habits-of-mind to construct understanding; the big ideas, unifying conceptions and informed opinions constructed; and communications to share and persuade others.	"Students establish connections between their current knowledge of science and the scientific knowledge found in many sources...." (p. 20). "Understanding science requires that an individual integrate a complex structure of many types of knowledge..." (p. 23). Scientific literacy means that a person...[can] read with understanding...; identify scientific issues...and express positions that are scientifically and technologically informed;... evaluate the quality of scientific information on the basis of its source and the methods used to generate it; [and] implies the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately" (p. 22). "Science often is a collaborative endeavor...[and] interactions among individuals and groups in the classroom can be vital in deepening the understanding of scientific concepts and the nature of scientific endeavors" (p. 31). "Encourage and model the skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science" (p. 32). "Students should begin developing the abilities to communicate, critique, and analyze their work and the work of others. This communication might be spoken or drawn as well as written" (pp. 122-123).	"The teacher...chooses the form of the assessment in relationship to the particular learning goals of the class and the experiences of the students" (p. 38). "The interaction of teachers and students concerning evaluation criteria helps students understanding the expectations for their work, as well as giving them experience in applying standards of scientific practice to their own and others' scientific efforts..." (p. 42). "...'Authentic assessment' ...calls for exercises that closely approximate the intended outcomes of science education [and]....require students to apply scientific knowledge and reasoning to situations similar to those they will encounter in the world outside the classroom, as well as to situations that approximate how scientists do their work" (p. 78). "Achievement data collected focus on the science content that is most important for students to learn" (p. 79).

Table 1 continued

Goals	Pedagogy	
	Constructivism	Authentic Assessment
Critical Thinking is inspired by a problematic situation that requires a judgment about what to believe or do and involves deliberation, judgment, and justification, sharing criteria based reasons why the support sustains the judgment.	"Students assess the efficacy of their efforts–they evaluate the data they have collected, re-examining or collecting more if necessary, and making statements about the generalizability of their findings" (p. 33). "...Structure science activities so that students are required to explain and justify their understanding, argue from data and defend their conclusions, critically assess and challenge the scientific explanations of one another" (p. 50). "When secondary sources...are used, students need to be made aware of the processes by which the knowledge presented in those sources was acquired and to understand that the sources are authoritative and accepted within the scientific community" (p. 31). "Even at the earliest grade levels, students should learn what constitutes evidence and judge the merits or strength of the data and information that will be used to make explanations....[checking] their explanations against scientific knowledge, experiences, and observations of others" (p. 122). "...They...will entertain the idea of a 'fair' test (a test in which only one variable at a time is changed)" (p 122). "Students should be able to... form a logical argument about the cause-and-effect relationships in the experiment" (p. 145).	"...Eliciting and analyzing explanations are useful ways of assessing school achievement...to tap the depth and breadth of the students understanding" (p. 92). "Select a piece of their own work to provide evidence of understanding...or their ability to conduct scientific inquiry. Explain...how...sample provides evidence of understanding. Critique a sample of their own work [and of others] using the teacher's standards and criteria for quality" (p. 88). Ultimately, students will "provide evidence from which to infer the extent and quality of their understanding of the nature of science...as well as the quality and extent of their scientific knowledge and their capacity to reason scientifically" (p. 99). Reasoning ability can be inferred from "...how well connected the chain of reasoning is, how explicit the student is about the assumptions made, [the extent implications for alternative assumptions have been considered, and the] ability of the student to communicate ideas" (pp. 100-101)

Table 2: Reforms, Visions and Standards–*Benchmarks for Science Literacy* (AAAS;1993)

Goals	Pedagogy	
	Constructivism	Authentic Assessment
Literacy involves the abilities and habits-of-mind to construct understanding; the big ideas, unifying conceptions and informed opinions constructed; and communications to share and persuade others.	"...Science literacy enhances... internal perceptions and reflections [that] can provide the person with a basis for making decisions and taking action" (p. 322). Encourage students to "ask questions about nature and to seek answers..." (p. 6) "...Reduce the number of experiments undertaken (making time available to probe questions more deeply)....[Students] frame the question, design the approach, estimate the time and costs involved, calibrate the instruments, conduct trial runs, write a report, and...respond to criticism" (p. 9). "They should be encouraged to 'check what you think against what you see.' As explanations take on more and more importance, teachers must insist that students pay attention to the explanations of others and remain open to new ideas" (p. 11). "Students should be actively involved in exploring phenomena that interest them both in and out of class...Children should have lots of time to talk about what they observe and to compare their observations with those of others. A premium should be placed on careful expression...." (p. 10). "By testing their models and changing them as more information is acquired, they begin to understand how science works" (p. 268).	"thresholds rather than average or advanced performance. It describes levels of understanding and ability that all students are expected to reach on the way to becoming science-literate" (p. 283). "Be able to connect one idea to other ideas and use it in thinking about new situations and in problems solving" (p. 283).

Table 2 continued

Goals	Pedagogy	
	Constructivism	Authentic Assessment
Critical Thinking is inspired by a problematic situation that requires a judgment about what to believe or do and involves deliberation, judgment, and justification, sharing criteria based reasons why the support sustains the judgment.	"...Conclusions presented to students (in books and in class)...should gradually be augmented by information on how the science community arrived at those conclusions...."How do we know that's true?" (p. 4) "...Learn how to use logic and evidence in making valid, persuasive arguments and in judging the arguments of others.....[through] lots of practice in formulating arguments, presenting them to classmates, responding to their criticisms, and critiquing the arguments of others" (p. 231). "The use or misuse of supporting evidence, the language used, and the logic of the argument presented are important considerations in judging how seriously to take some claim or proposition" (p. 298). "Buttress their statements with facts found in books, articles, and databases, and identify the sources used and expect others to do the same" (p. 299). "Question claims based on vague attributions...[or if made by] others outside the area of their particular expertise" (p. 199). "...assessing the impacts and consequences of technological systems" (p. 16) "describe their procedures with enough detail to enable others to replicate them, make greater use of tables and graph to summarize and interpret data, and submit their work to the criticism of others" (p. 16)	

Table 3: Reforms, Visions and Standards–*Curriculum and Evaluation Standards for School Mathematics (1989; NCTM) and Professional Standards for Teaching Mathematics* (NCTM;1991)

Goals	Pedagogy	
	Constructivism	Authentic Assessment
Literacy involves the abilities and habits-of-mind to construct understanding; the big ideas, unifying conceptions and informed opinions constructed; and communications to share and persuade others.	"Mathematical literacy,.... denotes an individual's abilities to explore, conjecture, and reason logically, as well as...to use a variety of mathematical methods effectively to solve nonroutine problems" (1989, p. 5). "Young children are active individuals who construct, modify, and integrates ideas by interacting with the physical world, materials, and other children" (1989, p. 17). "Good tasks can help students develop skills in the context of their usefulness" (1991, p. 24). "...Pose tasks that are based on sound and significant mathematics; ...students' understandings, interests, and experiences; develop students' mathematical understandings and skills; stimulate... connections and develop a coherent framework for mathematical ideas; call for problem formulation, problem solving, and mathematical reasoning; ...promote communication about mathematics; [and] ...promote... dispositions to do mathematics" (1991, p. 25). "Communicating helps children to clarify their thinking and sharpen their understanding" (1989, p. 26). "[Journals]...offer students the opportunity to reflect on their understandings and feelings" (1991, p. 49).	"...Journals give the teacher insights into students' thinking" (1991, p. 49) "Both teachers and students benefit from collaborating on assessment. Teachers can gain additional information and insights about students; students gain additional opportunities to integrate and reflect on their understanding" (1991, p. 49). Assessment "emphasizes connections between mathematics and other disciplines and connections to daily living" (1991, p. 89). "The teacher has provided an opportunity for written, oral, and visual communication in the context of a problem-solving activity" (1991, p. 99). The teacher "aligns assessment methods with what is taught and how it is taught" (1991, p. 110). "Through observations, questioning, and listening to students' explanations,... [teachers] uncover the thinking underlying their [students'] approaches....[and] probe the depth of students' understandings" (1991, p. 162). "Assess... mathematical knowledge..., ability..., language to communicate ideas..., disposition toward mathematics, understanding of the nature of mathematics..." (1989, p. 209).

Table 3 continued

Goals	Pedagogy	
	Constructivism	Authentic Assessment
Critical Thinking is inspired by a problematic situation that requires a judgment about what to believe or do and involves deliberation, judgment, and justification, sharing criteria based reasons why the support sustains the judgment.	"Students make conjectures publicly and try to convince themselves and one another of their validity" (1991, p. 47). "…Students need a great deal of time and many experiences to develop their ability to construct valid arguments in problem settings and evaluate the arguments of others" (1989, p. 81). "…Systematically collect, organize, and describe data; …make inference and convincing arguments that are based on data analysis; evaluate arguments that are based on data analysis…(1989, p. 105). "Teachers should consistently expect students to explain their ideas, to justify their solutions, and to persevere when they are stuck….and to learn to expect and ask for justifications and explanations from one another" (1991, p. 58). "Students should be encouraged to explain their reasoning process for reaching a given conclusion or to justify why their particular approach to a problem is appropriate….Emphasizing reasoning…empower[s] students to reach conclusions and justify statements on their own rather than to rely solely on…authority" (1991, p. 96). "The teacher expects students to look for evidence" (1991, p. 47). "Demonstrating respect for students' ideas does not imply…that teachers or students accept all ideas as reasonable or valid" (1991, p. 57).	Assess "students' ability to …use inductive reasoning to recognize patterns and form conjectures; use reasoning to develop plausible arguments for mathematical statements; …use deductive reasoning to verify conclusions, judge the validity of arguments, and construct valid arguments…(1989, p. 228); verify the results of procedures empirically…. (1989, p. 228); ….and …. monitor and reflect on their own thinking and performance" (1989, p. 233). "The teacher analyzes the students' explanations" (1991, p. 91).

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Table 4: Reforms, Visions and Standards–*Curriculum Standards for Social Studies: Expectations of Excellence* (NCSS;1994)

Goals	Pedagogy	
	Constructivism	Authentic Assessment
Literacy involves the abilities and habits-of-mind to construct understanding; the big ideas, unifying conceptions and informed opinions constructed; and communications to share and persuade others.	"Knowledge is constructed by learners as they attempt to fit new information, experiences, feelings, and relationships into their existing or emerging intellectual, aesthetic, and emotional constructs" (p. 7). "Instruction emphasises depth of development of important ideas within appropriate breadth of topic coverage and focuses on teaching these important ideas for understanding, appreciation, and life application" (p. 11). "The construction of meaning required to develop important social understanding takes time and is facilitated by interactive discourse" (p. 169). Promote "...acquiring information and manipulating data; developing and presenting policies, argument, and stories; constructing new knowledge; and participating in groups...to increase the students ability to express and advocate reasoned personal convictions within groups, recognize mutual ethical responsibility in groups, participate in negotiating conflicts and differences or maintain an individual position because of its ethical basis, work individually and in groups, and accept and fulfill responsibilities associated with citizenship in a democratic republic" (p. 7).	"Meaningful learning activities and assessment strategies that focus students' attention of the most important ideas embedded in what they are learning" (p. 11) "...Use accountability and grading systems that are compatible with instructional methods and that focus on accomplishment of major social understanding and civic efficacy goals" (p. 168). Use "...daily monitoring of the general effectiveness and quality of student participation in lessons and activities, ...augmenting traditional tests with performance evaluations, portfolios of student papers and projects, and essays focusing on higher-order thinking and applications" (pp. 171-172).

Table 4 continued

Goals	Pedagogy	
	Constructivism	Authentic Assessment
Critical Thinking is inspired by a problematic situation that requires a judgment about what to believe or do and involves deliberation, judgment, and justification, sharing criteria based reasons why the support sustains the judgment.	"…Students explore a variety of positions in a thorough, fair-minded manner….As each position is studied and discussed to determine the strongest points in favor…[and] in opposition to it, and the consequences that would follow from selecting it facilitate] students'…[gain capacity] to participate with others in making decisions about them" (p 10). "Conceptualize unfamiliar categories of information, establish cause/effect relationships, determine validity of information and arguments, and develop…understanding of an event, idea, or persons while meeting criteria of valid social studies research" (p. 8). Challenges: "authentic activities that call for real-life applications using the skills and content of the field" (p. 12) "Demonstrate an understanding that different scholars may describe the same event or situation in different ways but must provide reasons or evidence for their views" (p. 34). "Instructional methods and activities should be planned to encourage students to connect what they are learning to their prior knowledge and experience, to thinking critically and creatively about what they are learning, and to use it in authentic application situations" (p. 161). "In advancing their own ideas and responding critically to others, students are expected to build a case based on relevant evidence and arguments…" (p. 167).	"…Balance…[standardized tests] with more authentic performance assessments, [including]… speaking effectively or articulating a reasoned stance on a controversial issue" (p. 171).

Table 5: Reforms, Visions and Standards–*Standards for the English Language Arts* (NCTE & IRA, 1996)

Goals	Pedgagogy	
	Constructivism	Authentic Assessment
Literacy involves the abilities and habits-of-mind to construct understanding; the big ideas, unifying conceptions and informed opinions constructed; and communications to share and persuade others.	"[We] draw on our own sets of experiences and strategies as we use language to construct meanings from what we read, write, hear, say, observe, and represent. These meanings are individual and personal. Yet the range of possible meanings …is to a great extent, socially determined" (p. 22) Language is used "…for obtaining and communicating information, for literary response and expression, for learning and reflection, and for problem solving and application"(p. 16). "…Draw on students' real needs for language and to use these as a platform for motivating further learning and strengthening of their competencies" (p. 18). "Language users make 'meaning', constantly revising their initial understandings of what they read, hear, view, and create in light of what they learn from subsequent reading, listening, viewing, and creating. We learn language…to make sense of the world around us and to communicate our understandings with others…" (p. 19). "…Relevance to students' interests and other readings, relevance for students' roles in society and the workplace; literary quality; and balance and variety in form, style, and content" (p. 28).	"…Essential elements of the knowledge base…: know about and work with a broad range of texts, spoken and visual as well as written…; a repertoire of processes or strategies for creating, interpreting, an analyzing texts…and underlying systems of structures of language" (p. 15). "By being attentive to, and talking about their own learning strategies, students develop this sense of themselves as resourceful learners and provide their teachers with valuable insights into their development" (p. 9). "In response to questions about how progress toward the standards is to be evaluated, we strongly reaffirm the role of the teacher. By watching students closely, reflecting on their development, and guiding them when they need help, teachers both assess and advance their progress" (p. 69).

Table 5 continued

Goals	Pedagogy	
	Constructivism	Authentic Assessment
Critical Thinking is inspired by a problematic situation that requires a judgment about what to believe or do and involves deliberation, judgment, and justification, sharing criteria based reasons why the support sustains the judgment.	"...Effective critical thinkers... provide informed opinions about texts they encounter, ...support their interpretations with multiple forms of evidence;...[comprehend] the complexities and nuances of language" (p. 21). Students "...reflect on textual meaning from their own perspectives...and...evaluate texts...[for] logic, emotional appeal, and purpose" (p. 33); "As writers hear how different readers interpret and evaluate their work, they learn how to use constructive criticism to revise or recast their writing. " (p. 36) To "...interpret and create various types of texts.... entails sensitivity to the purpose, nature, and audience of a text, and to an ability to use this awareness to adapt language accordingly..." (p. 20). "...Through literary texts, [learn] to view their own lives and the world around them in new and different ways [and]... consider alternatives rather than simply accepting things as they are" (p. 30). "The ability to identify good topics, to gather information, and to evaluate, assemble, and interpret findings from the many general and specialized information sources...is one of the most vital skills that students can acquire" (p. 39).	"...Students should be able to use language....clearly..., strategically..., critically..., creatively" (p. 21).

Table 6: Reforms, Visions and Standards–*Technology for All Americans: A Rationale and Structure for the Study of Technology* (ITEA;1996)

Goals	Pedagogy	
	Constructivism	Authentic Assessment
Literacy involves the abilities and habits-of-mind to construct understanding; the big ideas, unifying conceptions and informed opinions constructed; and communications to share and persuade others.	"...Technological literacy is vital to individual, community, and national economic prosperity.... How people develop and apply technology has become critical to future generations, society, and even the Earth's continued ability to sustain life" (p. 6). "Technology...involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities..." (p. 16). "Technological design requires understanding of the use of resources and engages a variety of mental strategies, such as problem solving, visual imagery, and reason. These abilities can be developed through experiences in designing, modeling, testing, troubleshooting, observing, analyzing, and investigating" (p.18). "...Knowledge and understanding of the nature and a historical perspective of technology...help[s] [people]...understand and analyze current situations and issues...challenge and test their decisions about technology" (p. 25). Pupils apply their knowledge when drawing, planning, designing, problem solving, building, testing, and improving their solutions to problems....This process of critical thinking and creative activity can help children construct what they are learning into more meaningful knowledge structures" (p. 36).	It is proposed that "student assessment standards...include cognitive and process achievement indicators,...and appropriate formative and summative evaluation techniques" (p. 43).

Table 6 continued

Goals	Pedagogy	
	Constructivism	Authentic Assessment
Critical Thinking is inspired by a problematic situation that requires a judgment about what to believe or do involving deliberation, judgment, and justification, sharing criteria based reasons why the support sustains the judgment.	"Technological literacy.... involves...educational programs where learners become engaged in critical thinking as they design and develop products, systems, and environments to solve practical problems" (p. 1). "Sound decisions demand an understanding of the impacts, relationships, and costs of...technological activities.... Democracy demands shared responsibilities and contributions" (p. 8). "Technologically literate people should be able to read a newspaper or magazine article and react to those articles...on a basis of some understanding, not a basis of emotion" (Bloch, 1986, in ITEA, 1996, p. 22) "...Students...assess the impacts and consequences of these systems on individuals, society, and the environment...; produce models and develop real technological products, systems, and environments...; [and] learn how to apply principles...." (p. 38).	Learners of "technology need experience assessing various technological systems that will affect individuals, society, and the environment. They need to understand the process of assessment so that they can develop their own forecasts...[or] 'best guess estimates'" (p. 22).

Figure 1: The Effects of the Aggregate Impact of Several Changes

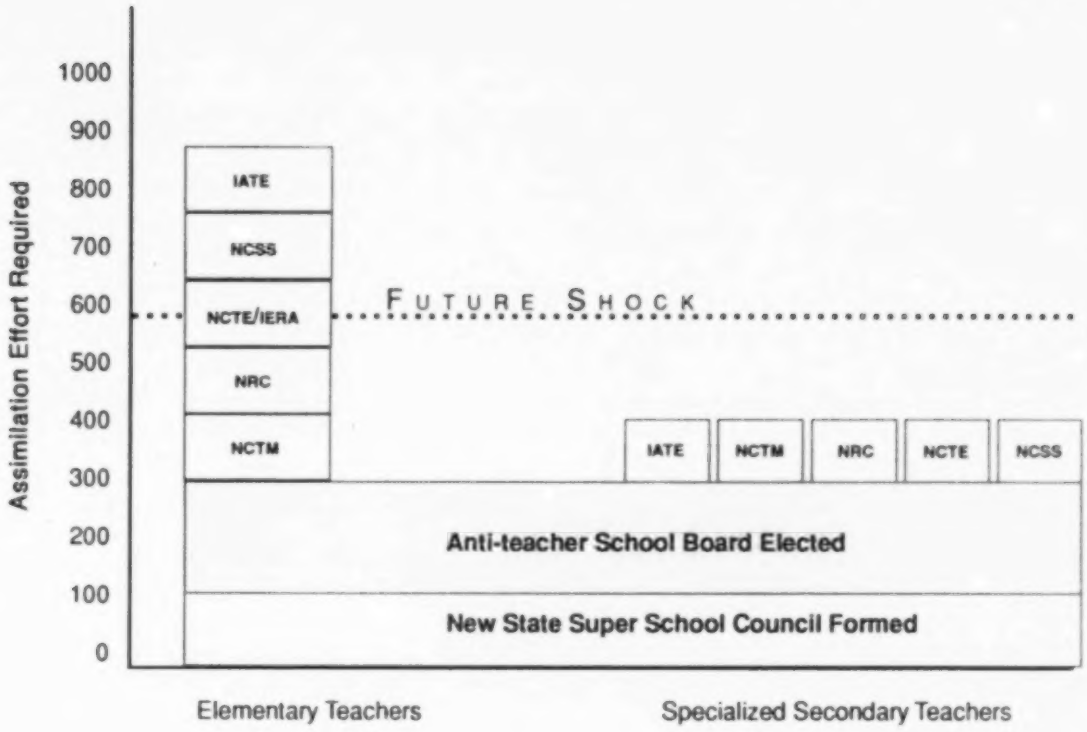

Figure 2: Changes as Incremental Metamorphosis